Amendments to the Claims

Please amend the claims as follows:

1. (currently amended) A method of forming a conductive contact, comprising the steps of:

depositing a source gas onto a substrate to form a fill ~~a contact hole~~ having a thickness of about 500 angstroms or greater within an opening in the substrate, the source gas comprising a component capable of diffusing into and corroding an adjacent metal layer;

removing excess material from the substrate to form the conductive contact ~~in the contact hole~~ within the opening~~, wherein~~ the contact ~~has~~ having a thickness of about 500 angstroms or greater; and

heating the conductive contact in a reactive gas at a temperature of about 700°C. or greater to reduce the component ~~within~~ throughout the thickness of the conductive contact without forming substantial cracks within the conductive contact.

2. (previously presented) The method of Claim 1, wherein the step of heating the contact comprises a rapid thermal anneal process.

3. (previously presented) The method of Claim 1, wherein the step of removing the excess material comprises chemical mechanical polishing.

4. (previously presented) The method of Claim 1, wherein the component comprises chlorine.

5. (previously presented) The method of Claim 1, wherein the source gas comprises a chlorine-containing precursor, and the component comprises chlorine.

6. (original) The method of Claim 5, wherein the chlorine-containing precursor comprises $TiCl_4$.

7. (original) The method of Claim 5, wherein the reactive gas comprises a nitrogen-containing gas.

8. (original) The method of Claim 7, wherein the reactive gas comprises ammonia.

9. (original) The method of Claim 5, wherein the contact comprises titanium nitride, the chlorine-containing precursor comprises titanium, and the source gas further comprises ammonia.

10. (original) The method of Claim 9, wherein the contact comprises boron-doped titanium nitride, and the source gas further comprises borane.

11. (currently amended) A method of forming a conductive contact, comprising the steps of:

depositing a source gas comprising a chlorine-containing precursor onto a substrate to form a fill having a thickness of about 500 angstroms or greater within an opening ~~a contact hole~~ in the substrate;

removing excess material from the substrate to form the conductive contact in the opening, ~~contact hole, wherein~~ the conductive contact ~~has~~ having a thickness of about 500 angstroms or greater; and

heating the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to decrease chlorine ~~within~~ throughout the thickness of the conductive contact by at least about 50% by wt. without forming substantial cracks within the conductive contact.

12. (previously presented) The method of Claim 11, wherein the step of heating the contact comprises a rapid thermal anneal process.

13. (previously presented) The method of Claim 11, wherein the step of removing the excess material comprises chemical mechanical polishing.

14. (previously presented) The method of Claim 11, wherein the chlorine-containing precursor comprises titanium, the source gas further comprises ammonia, and the contact comprises titanium nitride.

15. (original) The method of Claim 14, wherein the source gas further comprises borane, and the contact comprises boron-doped titanium nitride.

16. (currently amended) A method of forming a conductive contact, comprising the steps of:

depositing a source gas comprising a titanium and chlorine-containing precursor onto a substrate to ~~fill a contact hole~~ form a conductive contact within an opening in the substrate, the conductive contact having a thickness of at least about 500 angstroms;

removing excess material from the substrate ~~to form the contact in the contact hole,~~ ~~wherein~~ such that the conductive contact has a thickness of about 500 angstroms or greater; and

heating the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to decrease chlorine ~~within~~ throughout the thickness of the conductive contact without forming substantial cracks within the conductive contact.

17. (previously presented) The method of Claim 16, wherein the step of heating the contact comprises a rapid thermal anneal process.

18. (original) The method of Claim 16, wherein the source gas further comprises an ammonia precursor to form titanium nitride.

19. (original) The method of Claim 16, wherein the titanium and chlorine-containing precursor comprises $TiCl_4$.

20. (original) The method of Claim 18, wherein the source gas further comprises a borane precursor to form boron-doped titanium nitride.

21. (original) The method of Claim 16, wherein the nitrogen-containing gas comprises ammonia.

22. (currently amended) A method of forming a conductive contact, comprising the steps of:

depositing a source gas onto a substrate to form a fill having a thickness of about 500 angstroms or greater within a contact hole in the substrate; the source gas comprising $TiCl_4$;

removing excess material from the substrate to form the conductive contact in the contact hole, ~~wherein~~ the conductive contact ~~has~~ having a thickness of about 500 angstroms or greater; and

thermally annealing the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to decrease chlorine ~~within~~ throughout the thickness of the conductive contact without forming substantial cracks within the conductive contact; the nitrogen-containing gas comprising ammonia.

23. (previously presented) The method of Claim 22, wherein the step of thermally annealing the contact comprises a rapid thermal anneal at about 700°C. to about 800°C.

24. (original) The method of Claim 22, wherein the source gas further comprises an ammonia precursor to form titanium nitride.

25. (original) The method of Claim 24, wherein the source gas further comprises a borane precursor to form boron-doped titanium nitride.

26. (currently amended) A method of forming a conductive contact, comprising the steps of:

forming a titanium silicide layer over a substrate and within a contact hole;

depositing a titanium nitride layer onto the titanium silicide layer to form a fill within the contact hole by combining a titanium and chlorine-containing precursor with a nitrogen-containing precursor to form a titanium nitride fill having a thickness of about 500 angstroms or greater;

removing excess material from the substrate to form the conductive contact in the contact hole, the conductive contact having a thickness of at least about 500 angstroms and comprising an amount of chlorine; and

thermally annealing the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to decrease the amount of chlorine throughout the thickness without forming substantial cracks within the conductive contact.

27. (previously presented) The method of Claim 26, wherein the step of thermally annealing the contact comprises a rapid thermal anneal at a temperature of 700°C. to about 800°C.

28. (original) The method of Claim 26, wherein the step of depositing the titanium nitride layer comprises combining $TiCl_4$ and NH_3 in a thermal chemical vapor deposition.

29. (original) The method of Claim 26, wherein the step of depositing the titanium nitride layer further comprises combining the precursors with a B_2H_6 precursor to form boron-doped titanium nitride.

30. (currently amended) A method of forming a conductive contact, comprising the steps of:

forming a titanium silicide layer over a substrate and within ~~a contact hole~~ an opening in the substrate;

depositing a boron-doped titanium nitride ~~layer~~ material onto the titanium silicide layer to fill the ~~contact hole~~ opening by combining a titanium and chlorine-containing precursor with a nitrogen-containing precursor and a borane precursor to form a boron-doped titanium nitride fill having a thickness of about 500 angstroms or greater and comprising an amount of chlorine;

removing excess material from the substrate to form the conductive contact in the ~~contact hole~~ opening, the conductive contact having a thickness of at least about 500 angstroms; and

thermally annealing the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to decrease the amount of chlorine throughout the thickness of the conductive contact without forming substantial cracks within the conductive contact.

31. (previously presented) The method of Claim 30, wherein the step of thermally annealing the contact comprises a rapid thermal anneal at a temperature of 700°C. to about 800°C.

32. (original) The method of Claim 30, wherein the step of depositing the boron-doped titanium nitride layer comprises combining $TiCl_4$, NH_3, and B_2H_6 in a thermal chemical vapor deposition.

33. (currently amended) A method of forming a conductive contact ~~on a semiconductor substrate comprising~~ within an opening through an insulative layer, the opening having sidewalls and extending to an underlying silicon-comprising substrate, the method comprising the steps of:

forming a titanium silicide layer over the insulative layer ~~and~~ within the opening;

depositing a source gas over the titanium silicide layer ~~overlying the insulative layer and within the opening~~ to form a ~~layer~~ fill comprising titanium nitride having a thickness of about 500 angstroms or greater within the opening; the source gas comprising a chlorine-containing precursor;

removing excess of the titanium nitride layer to form the conductive contact within the opening; the contact having a concentration of chlorine and a thickness of at least about 500 angstroms; and

subjecting the conductive contact to a heat treatment in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine throughout the thickness of the conductive contact without forming substantial cracks within the conductive contact.

34. (previously presented) The method of Claim 33, wherein the step of subjecting the contact to the heat treatment comprises a rapid thermal anneal.

35. (previously presented) The method of Claim 33, wherein the contact is subjected to the heat treatment at a temperature of at least about 700°C. to about 800°C.

36. (previously presented) The method of Claim 33, wherein the step of forming the titanium silicide layer comprises a plasma enhanced chemical vapor deposition of a titanium precursor with a silicon precursor to form titanium silicide.

37. (previously presented) The method of Claim 33, wherein the step of depositing the source gas to form the titanium nitride layer comprises a thermal chemical vapor deposition.

38. (original) The method of Claim 33, wherein the source gas comprises a titanium and chlorine-containing precursor and a nitrogen-containing precursor to form titanium nitride.

39. (original) The method of Claim 38, wherein the source gas further comprises a borane precursor to form a boron-doped titanium nitride contact.

40. (canceled)

41. (original) The method of Claim 33, wherein the step of subjecting the contact to a heat treatment reduces the chlorine concentration of the contact by at least about 75% by wt.

42. (original) The method of Claim 33, wherein the step of subjecting the contact to a heat treatment reduces the chlorine concentration of the contact by at least about 95% by wt.

43. (original) The method of Claim 33, wherein the chlorine concentration of the heat treated conductive contact is less than about 1% by wt.

44. (original) The method of Claim 33, wherein the chlorine concentration of the heat treated conductive contact is less than about 3% by wt.

45. (original) The method of Claim 33, wherein the chlorine concentration of the heat treated conductive contact is less than about 4% by wt.

46. (currently amended) A method of forming a conductive contact, comprising:

depositing a first source gas comprising $TiCl_4$, H_2, and SiH_4 precursors onto a substrate to form a titanium silicide layer in an opening;

depositing a second source gas comprising $TiCl_4$ and NH_3 precursors onto the titanium silicide layer to form a titanium nitride layer having a thickness of about 500 angstroms or greater within the opening;

removing excess of the titanium nitride layer by chemical mechanical polishing while maintaining the titanium nitride layer within the opening to form the conductive contact; the conductive contact having a concentration of chlorine and a thickness of at least about 500 angstroms; and

exposing the conductive contact to a nitrogen-containing gas by thermal anneal at a temperature of about 700°C. or greater to reduce the concentration of chlorine throughout the thickness of the conductive contact without forming substantial cracks within the conductive contact.

47. (original) The method of Claim 46, wherein the nitrogen-containing gas comprises ammonia.

48. (previously presented) The method of Claim 46, wherein the thermal anneal is conducted at a temperature of at least about 700°C. to about 800°C.

49. (original) The method of Claim 46, wherein the chlorine concentration of the thermally annealed contact is less than about 3% by wt.

50. (currently amended) A method of forming a conductive contact, comprising:

depositing a first source gas comprising $TiCl_4$, H_2, and SiH_4 precursors onto a substrate to form a titanium silicide layer in an opening;

depositing a second source gas comprising $TiCl_4$, NH_3, and B_2H_6 precursors onto the titanium silicide layer to form a boron-doped titanium nitride layer having a thickness of about 500 angstroms or greater within the opening;

removing excess of the boron-doped titanium nitride layer by chemical mechanical polishing while maintaining the boron-doped titanium nitride layer within the opening to form the conductive contact; the conductive contact having a concentration of chlorine and a thickness of about 500 angstroms or greater; and

exposing the conductive contact to a nitrogen-containing gas by thermal anneal at a temperature of about 700°C. or greater to reduce the concentration of chlorine throughout the thickness of the conductive contact without forming substantial cracks within the contact.

51. (original) The method of Claim 50, wherein the chlorine concentration of the thermally annealed conductive contact is less than about 3% by wt.

52. (currently amended) A method of forming a conductive contact in ~~a semiconductor device comprising~~ an opening through an insulative layer, the opening having sidewalls and extending to an underlying silicon-comprising substrate, the method comprising the steps of:

forming a layer comprising titanium silicide over the insulative layer and the substrate within the opening;

depositing a layer of boron-doped titanium nitride over the titanium silicide layer from a titanium and chlorine-containing precursor to fill the opening, the boron-doped titanium nitride fill layer having a thickness of about 500 angstroms or greater;

removing excess of the boron-doped titanium nitride fill layer overlying the insulative layer while leaving a portion of the boron-doped titanium nitride layer within the opening to form the conductive contact having a thickness of at least about 500 angstroms; and

heat treating the conductive contact at a temperature of about 700°C. or greater to remove chlorine ~~from~~ throughout the thickness of the conductive contact without forming substantial cracks therein.

53. (original) The method of Claim 52, wherein the opening has an aspect ratio of about 3:1 or greater.

54. (original) The method of Claim 52, wherein the opening is about 0.25 μm or less.

55. (canceled)

56. (original) The method of Claim 52, wherein the conductive contact has a thickness of about 1000 to about 3000 angstroms.

57. (original) The method of Claim 52, wherein the step of depositing the boron-doped titanium nitride layer is by thermal chemical vapor deposition using a gaseous mixture comprising titanium tetrachloride, ammonia, and diborane.

58. (original) The method of Claim 57, wherein the step of depositing the boron-doped titanium nitride layer is performed by flowing about 100 to about 500 sccm titanium tetrachloride, about 100 to about 1000 sccm ammonia, and about 100 to about 1000 sccm diborane over the substrate.

59. (currently amended) The method of Claim 52, wherein the titanium nitride layer comprises an amount of boron to substantially eliminate peeling of the conductive contact from the sidewall of the opening and cracking of the insulative layer, and an amount of nitrogen to provide an effective amount of conductivity to an active area within the substrate.

60. (original) The method of Claim 59, wherein the active area comprises a source or drain region.

61. (currently amended) The method of Claim 52, wherein the step of depositing the boron-doped titanium nitride layer comprises:

depositing a layer of titanium nitride over the titanium silicide layer;

depositing a layer of boron-doped titanium nitride over the titanium nitride layer; and

depositing a layer of titanium nitride over the boron-doped titanium nitride layer ~~to fill the opening~~; and

repeating the foregoing steps to form the boron-doped titanium nitride layer having a thickness of about 500 angstroms or greater as a multi-layered fill within the opening.

62. (currently amended) The method of Claim 52, wherein the step of depositing the boron-doped titanium nitride layer comprises depositing a layer of titanium nitride over the titanium silicide layer, and sequentially depositing overlying layers of boron-doped titanium nitride and titanium nitride to form a multi-layered film within the opening having a thickness of about 500 angstroms or greater; the fill comprising a boron-doped titanium nitride layer interposed between two titanium nitride layers.

63. (original) The method of Claim 62, wherein each of the layers of the multi-layered film are about 100 to about 500 angstroms thick.

64. (original) The method of Claim 52, wherein the step of depositing the titanium silicide layer is by plasma enhanced chemical vapor deposition using a source gas comprising titanium tetrachloride and a silicon precursor.

65. (original) The method of Claim 52, wherein the step of depositing the titanium silicide layer comprises the steps of sputtering titanium onto the substrate, and annealing the titanium.

66. (currently amended) A method of forming a conductive contact in an opening of a semiconductor substrate, the opening formed in an insulative layer and extending to an underlying silicon-comprising substrate, the opening defined by sidewalls and a bottom portion; the method comprising the steps of:

forming a layer comprising titanium silicide over the substrate and within the opening; and

depositing a boron-doped titanium nitride material over the titanium silicide layer and into the opening to form a fill having a thickness of about 500 angstroms or greater;

removing excess material from the substrate while leaving the boron-doped titanium nitride ~~material~~ fill in the opening to form the contact, wherein the contact has a thickness of about 500 angstroms or greater; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine throughout the thickness of the contact to less than about 3% by wt. without forming substantial cracks within the contact;

wherein the conductive contact comprises an amount of boron to substantially eliminate peeling of the contact from the sidewall of the opening and cracking of the insulative layer, and an amount of nitrogen to provide an effective amount of conductivity to an active area within the substrate.

67. (currently amended) A method of forming a conductive contact in a semiconductor device comprising an opening through an insulative layer, the opening having sidewalls and extending to an underlying silicon-comprising substrate, the method comprising the steps of:

depositing a layer comprising titanium silicide over the insulative layer and the substrate within the opening; and

forming a titanium nitride layer over the titanium silicide by depositing a layer of titanium nitride over the titanium silicide layer; and sequentially depositing overlying layers of boron-doped titanium nitride and titanium nitride to fill the opening, wherein the boron-doped titanium nitride layer is interposed between two titanium nitride layers and the fill has a thickness of about 500 angstroms or greater;

removing excess ~~material~~ fill overlying the insulative layer while leaving the fill ~~contact~~ within the opening to form the contact; the contact having a concentration of chlorine and a thickness of about 500 angstroms or greater; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine to less than about 3% by wt. without forming substantial cracks within the contact;

wherein the contact comprises an amount of boron to substantially eliminate peeling of the contact from the sidewall of the opening and cracking of the insulative layer, and an amount of nitrogen to provide an effective amount of conductivity to an active area within the substrate.

68. (currently amended) A method of forming a semiconductor device, comprising the steps of:

forming an insulative layer over a silicon-comprising substrate comprising an active area;

forming an opening in the insulative layer to expose the active area of the substrate, the opening having sidewalls;

forming a seed layer comprising titanium silicide over the insulative layer and the substrate within the opening; and

forming a layer comprising titanium nitride over the seed layer to form a fill within the opening having a thickness of about 500 angstroms or greater;

removing excess fill material overlying the insulative layer ~~while leaving the~~ to form a conductive contact within the opening; the contact having a concentration of chlorine and a thickness of about 500 angstroms or greater; and

heating the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine to less than about 3% by wt. throughout the thickness of the contact and without forming substantial cracks within the contact.

69. (currently amended) A method of forming a semiconductor device, comprising the steps of:

forming an insulative layer over a silicon-comprising substrate comprising an active area;

forming an opening in the insulative layer to expose the active area of the substrate, the opening having sidewalls;

forming a seed layer comprising titanium silicide over the insulative layer and the substrate within the opening; and

forming a layer comprising boron-doped titanium nitride over the seed layer to form a conductive fill within the opening;

removing excess fill material overlying the insulative layer ~~while leaving the~~ to form a conductive contact within the opening; the contact having a concentration of chlorine and a thickness of about 500 angstroms or greater; and

heating the conductive contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine to less than about 3% by wt. without forming substantial cracks within the contact;

whereby the conductive contact comprises an amount of boron effective to provide the contact with a level of adhesion to the insulative layer within the opening to substantially eliminate peeling of the contact from the sidewalls of the opening, and a level of thermal stress to substantially eliminate cracking of the insulative layer; and an amount of nitrogen effective to maintain the conductivity of the contact at a predetermined level for an effective electrical contact with the active area.

70. (currently amended) A method of forming a semiconductor device, comprising the steps of:

forming an insulative layer over a silicon-comprising substrate comprising a conductive area;

forming an opening in the insulative layer to expose the conductive area of the substrate, the opening having sidewalls;

forming a seed layer comprising titanium silicide over the insulative layer and the substrate within the opening; and

filling the opening with alternating layers of titanium nitride and boron-doped titanium nitride material to form a fill having a thickness of at least about 500 angstroms within the opening;

removing excess fill material overlying the insulative layer to form a conductive contact within the opening; the contact having a concentration of chlorine and a thickness of about 500 angstroms or greater; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine throughout the thickness of the contact to less than about 3% by wt. without forming substantial cracks within the contact;

wherein the boron-doped titanium nitride layer is interposed between two titanium nitride layers, and the boron-doped titanium nitride layer comprises an amount of boron effective to provide the conductive contact with a level of adhesion to the insulative layer within the opening to substantially eliminate peeling of the conductive contact from the sidewalls of the opening, and a level of thermal stress to substantially eliminate cracking of the insulative layer; and an amount of nitrogen effective to maintain the conductivity of the contact at a predetermined level for an effective electrical contact with the conductive area.

71. (currently amended) A method for filling high aspect ratio contact openings, comprising the steps of:

providing a substrate having a silicon-comprising substrate and an insulative layer formed thereon, the insulative layer having a surface and at least one contact opening formed therein to the substrate; the contact opening having an aspect ratio of at least 3:1;

forming a seed layer comprising titanium silicide over the insulative layer and the surface of the substrate within the contact opening; and

forming a titanium nitride film over the seed layer to form a fill within the opening, the fill having a thickness of at least about 500 angstroms;

removing excess material overlying the insulative layer while leaving the titanium nitride film ~~contact~~ within the opening to form ~~the~~ a conductive contact; the contact having a thickness of about 500 angstroms or greater and a concentration of chlorine without substantial cracks; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine <u>throughout the thickness of the contact</u> to less than about 3% by wt.

72. (currently amended) A method for filling high aspect ratio contact openings, comprising the steps of:

providing a substrate having a silicon-comprising substrate and an insulative layer formed thereon, the insulative layer having a surface and at least one contact opening formed therein to the substrate; the contact opening having an aspect ratio of at least 3:1;

forming a seed layer comprising titanium silicide over the insulative layer and the surface of the substrate within the contact opening; and

forming a boron-doped titanium nitride film over the seed layer <u>to form a fill within the opening having a thickness of about 500 angstroms or more;</u>

removing excess <u>fill</u> material overlying the insulative layer while leaving the contact within the opening; the contact having a concentration of chlorine, a thickness of at least about 500 angstroms, and substantially no cracks; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine <u>throughout the thickness of the contact</u> to less than about 3% by wt.

73. (currently amended) A method for filling high aspect ratio contact openings, comprising the steps of:

providing a substrate having a silicon-comprising substrate and an insulative layer formed thereon, the insulative layer having a surface and at least one contact opening formed therein to the substrate; the contact opening having an aspect ratio of at least 3:1;

forming a seed layer comprising titanium silicide over the insulative layer and the surface of the substrate within the contact opening; and

forming a multi-layered film over the seed layer to fill the opening, the film comprising a layer comprising boron-doped titanium nitride interposed between two layers comprising titanium nitride layer, and having a thickness of about 500 angstroms or greater ;

removing excess ~~material~~ of the film overlying the insulative layer while leaving the contact within the opening; the contact having a concentration of chlorine, a thickness of at least about 500 angstroms, and substantially no cracks; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the concentration of chlorine throughout the thickness of the contact to less than about 3% by wt.

74-100. (cancelled)

101. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a conductive material to form the conductive contact, the contact having a thickness of at least about 500 angstroms and comprising a component capable of diffusing into and corroding an adjacent metal layer thereto; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater reduce the component ~~within~~ throughout the thickness of the contact by at least about 50% by wt, without forming substantial cracks within the contact.

102. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a conductive material comprising chlorine to form the conductive contact, the contact having a thickness of at least about 500 angstroms; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to reduce the component throughout the thickness of the contact without forming substantial cracks within the contact.

103. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a conductive material comprising chlorine to form the conductive contact, the contact having a thickness of at least about 500 angstroms; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the component <u>throughout the thickness of the contact</u> without forming substantial cracks within the contact.

104. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a titanium nitride material comprising chlorine to form the conductive contact, the contact having a thickness of at least about 500 angstroms; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the component <u>throughout the thickness of the contact</u> without forming substantial cracks within the contact.

105. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a titanium boronitride material comprising chlorine to form the conductive contact, the contact having a thickness of about 500 angstroms or greater; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the component <u>throughout the thickness of the contact</u> without forming substantial cracks within the contact.

106. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a conductive material to form the conductive contact by depositing sequential layers of titanium nitride and titanium boronitride into the opening, the

conductive contact comprising a component capable of diffusing into and corroding an adjacent metal layer thereto and having a thickness of about 500 angstroms or greater; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to reduce the component <u>throughout the thickness of the contact</u> without forming substantial cracks within the contact.

107. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a conductive material to form the conductive contact by depositing sequential layers of titanium nitride and titanium boronitride into the opening, the conductive contact comprising chlorine and having a thickness of about 500 angstroms or greater; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the component <u>throughout the contact</u> without forming substantial cracks within the contact.

108. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

filling the opening with a conductive material to form the conductive contact by depositing overlying layers of titanium nitride and titanium boronitride into the opening, the conductive contact comprising chlorine and having a thickness of about 500 angstroms or greater; and

heating the contact in a nitrogen-containing gas at a temperature of about 700°C. or greater to reduce the component <u>throughout the contact</u> without forming substantial cracks within the contact.

109. (currently amended) A method of forming a conductive contact in an opening in an insulative layer disposed on a substrate, comprising the steps of:

forming a layer of titanium silicide on the substrate within the opening;

filling the opening with a conductive material to form the conductive contact, the contact having a thickness of about 500 angstroms or greater; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to remove from throughout the contact at least about 50% by wt. of a component capable of diffusing into and corroding an adjacent metal layer thereto without forming substantial cracks within the contact.

110. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, the opening having an aspect ratio of about 3:1 or greater, the method comprising the steps of:

filling the opening with titanium boronitride to form the conductive contact having a thickness of about 200 angstroms or greater, the conductive contact comprising chlorine and having a thickness of about 500 angstroms or greater; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to remove from throughout the contact at least about 50% by wt. of a component capable of diffusing into and corroding an adjacent metal layer thereto without forming substantial cracks within the contact.

111. (previously presented) The method of Claim 110, wherein the conductive contact has a thickness of about 1000 to about 3000 angstroms.

112. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

forming the conductive contact by depositing a gaseous mixture comprising titanium tetrachloride and ammonia into the opening, the contact having a thickness of about 500 angstroms or greater and comprising chlorine; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% by wt. of the chlorine from throughout the contact without forming substantial cracks within the contact.

113. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

forming the conductive contact by depositing a gaseous mixture comprising titanium tetrachloride, ammonia, and diborane into the opening, the contact having a thickness of about 500 angstroms or greater and comprising chlorine; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% by wt. of the chlorine from <u>throughout</u> the contact without forming substantial cracks within the contact.

114. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

forming the conductive contact by depositing a gaseous mixture comprising titanium tetrachloride and ammonia into the opening, the conductive contact comprising a concentration of chlorine and having a thickness of about 500 angstroms or greater; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to reduce the chlorine concentration by at least about 50% by wt. <u>throughout the contact</u> without forming substantial cracks within the contact.

115. (previously presented) The method of Claim 114, wherein the gaseous mixture further comprises diborane.

116. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

forming the conductive contact by depositing a gaseous mixture comprising titanium tetrachloride and ammonia into the opening, the conductive contact comprising a concentration of chlorine and having a thickness of about 500 angstroms or greater; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to reduce the chlorine concentration to less than about 4% by wt. throughout the contact without forming substantial cracks within the contact.

117. (currently amended) A method of forming a conductive contact in an opening in an insulative layer overlying a substrate, the opening having insulative sidewalls; the method comprising the steps of:

forming the conductive contact by depositing a gaseous mixture comprising titanium tetrachloride, ammonia and diborane into the opening, the conductive contact comprising a concentration of chlorine and having a thickness of about 500 angstroms or greater; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to reduce the chlorine concentration throughout the contact without forming substantial cracks within the contact;

wherein the contact comprises an amount of boron for effective adhesion of the contact to the insulative sidewalls of the opening to substantially eliminate peeling of the contact from the sidewalls and cracking of the insulative layer.

118. (previously presented) The method of Claim 117, wherein the contact comprises a level of nitrogen for an effective level of conductivity to an active area within the substrate.

119. (currently amended) A method of forming a conductive contact in an opening in an insulative layer, comprising the steps of:

depositing a gaseous mixture comprising titanium tetrachloride and ammonia within the opening to form a layer of titanium nitride;

depositing a gaseous mixture comprising titanium tetrachloride, ammonia and diborane within the opening to form a layer of titanium boronitride over the titanium nitride layer;

depositing a gaseous mixture comprising titanium tetrachloride and ammonia within the opening to form a layer of titanium nitride over the titanium boronitride layer;

repeating the steps of depositing the gaseous mixtures to form sequential layers of titanium nitride and titanium boronitride to form the conductive contact to a thickness of about 500 angstroms or greater, the contact having a concentration of chlorine; and

heating the contact in a reactive gas at a temperature of about 700°C. or greater to reduce the chlorine concentration throughout the contact without forming substantial cracks within the contact.

120. (currently amended) A method of forming a barrier layer on a substrate, comprising the steps of:

forming a layer of titanium nitride over the substrate, the titanium nitride layer having a thickness of at least about 500 angstroms and comprising a concentration of chlorine; and

heating the titanium nitride layer in a reactive gas at a temperature of about 700°C. or greater to reduce the chlorine concentration ~~within~~ throughout the titanium nitride layer by at least about 50% without forming substantial cracks within the titanium nitride layer.

121. (currently amended) A method of forming a barrier layer on a substrate, comprising the steps of:

depositing a gaseous mixture comprising titanium tetrachloride and ammonia to form the barrier layer on the substrate, the barrier layer having a thickness of at least about 500 angstroms and a concentration of chlorine; and

heating the barrier layer in a reactive gas at a temperature of about 700°C. or greater to reduce the chlorine concentration ~~within~~ throughout the barrier layer by at least about 50% without forming substantial cracks within the barrier layer.

122. (currently amended) A method of forming a barrier layer on a substrate, comprising the steps of:

forming a layer of titanium boronitride over the substrate, the titanium boronitride layer having a thickness of at least about 500 angstroms and a concentration of chlorine; and

heating the titanium boronitride layer in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% of the chlorine ~~from~~ throughout the titanium boronitride layer without forming substantial cracks within the titanium boronitride layer.

123. (currently amended) A method of forming a barrier layer on a substrate, comprising the steps of:

depositing a gaseous mixture comprising titanium tetrachloride, ammonia and diborane to form the barrier layer on the substrate, the barrier layer having a thickness of at least about 500 angstroms and a concentration of chlorine; and

heating the barrier layer in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% of the chlorine from throughout the barrier layer without forming substantial cracks within the barrier layer.

124. (previously presented) A method of forming a semiconductor device, comprising the steps of:

forming a layer of titanium nitride over a substrate, the titanium nitride layer having a thickness of at least about 500 angstroms and a concentration of chlorine;

heating the titanium nitride layer in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% of the chlorine from throughout the titanium nitride layer without forming substantial cracks within the titanium nitride layer; and

depositing a conductive layer over the titanium nitride layer.

125. (previously presented) The method of Claim 124, wherein the conductive layer comprises an interconnect.

126. (previously presented) The method of Claim 125, wherein the interconnect comprises aluminum.

127. (currently amended) A method of forming a semiconductor device, comprising the steps of:

depositing a gaseous mixture comprising titanium tetrachloride and ammonia on a substrate to form a layer of titanium nitride, the titanium nitride layer having a thickness of at least about 500 angstroms and a concentration of chlorine;

heating the titanium nitride layer in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% of the chlorine from throughout the titanium nitride layer without forming substantial cracks within the titanium nitride layer; and

depositing a conductive layer over the titanium nitride layer.

128. (currently amended) A method of forming a semiconductor device, comprising the steps of:

forming a layer of titanium boronitride over a substrate, the titanium boronitride layer having a thickness of at least about 500 angstroms and a concentration of chlorine; and

heating the titanium boronitride layer in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% by wt. of the chlorine from throughout the titanium boronitride layer without forming substantial cracks within the titanium boronitride layer; and

depositing a conductive layer over the titanium boronitride layer.

129. (currently amended) A method of forming a semiconductor device, comprising the steps of:

depositing a gaseous mixture comprising titanium tetrachloride, ammonia and diborane on a substrate to form a layer of titanium boronitride having a thickness of at least about 500 angstroms and a concentration of chlorine;

heating the titanium boronitride layer in a reactive gas at a temperature of about 700°C. or greater to remove at least about 50% by wt. of the chlorine from throughout the layer without forming substantial cracks within the titanium nitride layer; and

depositing a conductive layer over the titanium boronitride layer.